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OSIRIS-REx Sample Acquisition and Implications for the Nature of the Returned Sample from Asteroid (101955) Bennu

DANTE LAURETTA

University of Arizona

Presenting Author: lauretta@arizona.edu

NASA's OSIRIS-REx spacecraft collected regolith from asteroid (101955) Bennu [1-2], which it will deliver to Earth in 2023. Images of sample collection show that spacecraft interaction mobilized rocks, liberated fine dust from the subsurface [3-4], and created a debris plume. Thermal emission spectroscopy of particulates that landed on the OTES instrument's fore optics reveal deeper absorptions than observed during spacecraft surveys, as well as a new absorption at 605 cm^{-1} (~16.5 μm) attributed to Mg-OH bonds in phyllosilicates [4-5]. The spectra are consistent with those of the most aqueously altered carbonaceous chondrites (type 1 or 2). Filter photometry and VIS-NIR spectroscopy show that the freshly exposed surface has a lower normal albedo and is spectrally redder than the original surface. In addition, a spectral band minimum near 0.55 μm, attributed to magnetite, is more pronounced. These spectral properties represent the starting point for surface changes that arise from space weathering on Bennu, confirming predictions from color-ratio mapping [6]. Digital terrain models show that the sampling event formed an elliptical crater ~9 m long. Crater scaling relationships indicate that formation of such a large crater requires a bulk density substantially lower than that of the whole asteroid [7] but consistent with analysis of spacecraft accelerometer data from the moment of contact [8]. Momentum build-up measured during robotic arm motions constrains the total mass of sample stowed to 250 ± 101 g [9].

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